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Grey correlation degree-based Chinese public sports service public satisfaction index model research

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ABSTRACT

With booming development of sports undertakings, public sports service has also become important parts of Chinese service industry. Though in recent years, Chinese public sports service has greatly changed, it still has shortcomings in some problems, public satisfaction index is still not very high. The paper takes Chinese sports service industry development constraint numerous factors as research objects, by analyzing its development changes and public participation status, it analyzes Chinese public satisfaction index on public sports service. Firstly, establish public satisfaction index-based grey correlation degree model, by comparing correlation degrees values sizes, samples indicator that has maximum impacts on public satisfaction index to make further analysis. Secondly, establish analytic hierarchy process-based public sports service public satisfaction index evaluation model, construct hierarchical structure, by comparing evaluation weights sizes, finally it gets conclusions: above 50% public are very satisfied with public sports services, little ones feel normal, but still a small proportion of people are dissatisfied. Therefore, Chinese government should strengthen management on public sports service, perfect management mechanism, dedicate in improving public satisfaction index and meet public sports demands.

KEYWORDS

Public sports service; Public satisfaction index; Grey correlation degree; Analytic hierarchy process.



INTRODUCTION

A public sport service is an important part of sports system, its public satisfaction index is the key to evaluate sports service work is qualified or not, it ought to measure and analyze by public satisfaction index. With respect to this, many scholars have gained achievements, and put forward some feasible suggestions.

Li Zheng-Zheng in the article “Urban residents sports public service satisfaction index investigation research”, he found some causes that people were dissatisfied with sports culture, and then provided guarantee for promoting living standards. The research took cities as examples, by referencing literatures, investigating information, analyzing statistics and so on, it discussed urban sports public services’ concrete contents, satisfaction index and each kind of humanistic geographic factors. Finally it got the conclusion: urban sports publics service satisfaction index was mainly composed of sports each department organizing services, public sports facilities construction services and others five common factors, which provided important theoretical references for Chinese urban and rural public sports cultural undertakings development.

Wang Meng-Yang in the article “government public sports service satisfaction index performance estimation indicators’ construction”, took urban and rural public sports culture as main research objects, pointed out that in contemporary, economy rapidly developed, researched on Chinese urban and rural public sports culture, and put forward how to meet more people requirements. The paper through visiting each school, collecting urban and rural residents’ current stage public sports satisfaction index, as well as researching on government macro-control, current stage Chinese sports system, sports resources, finally put forward that it not only should improve Chinese present system, but also should spread public sports importance on contemporary residents by education communication, so that could propel to current Chinese public sports cultural industries development.

Li Yan-Ru in the article “Chinese folk-custom sports culture and its resource exploitation research”, under the social environment of urban and rural construction harmonious steady development, studied residents satisfaction index on public sports culture. The paper through utilizing analytic investigation research method, it studied contemporary urban and rural sports cultural integration development, and then put forward that it should gradually establish urban and rural sports system, strengthen administrative management strength on sports so that arrived at residents satisfaction index on sports culture in realistic significances.

The paper utilizes mathematics grey correlation degree method and analytic hierarchy process, establishes regarding public sports services satisfaction index model, and then studies Chinese public satisfaction index on public sports services to provide theoretical basis for Chinese public sports service industry further development.

PUBLIC SPORTS SERVICES EVALUATION INDICATOR GREY CORRELATION DEGREE MODEL ESTABLISHMENTS

Sports public services are key factors that affect sports development, are important parts of sports system institution. Public sport venues and places, public sport service content and public sport service qualities and so on, all are key factors that restrict Chinese sports service industry development.

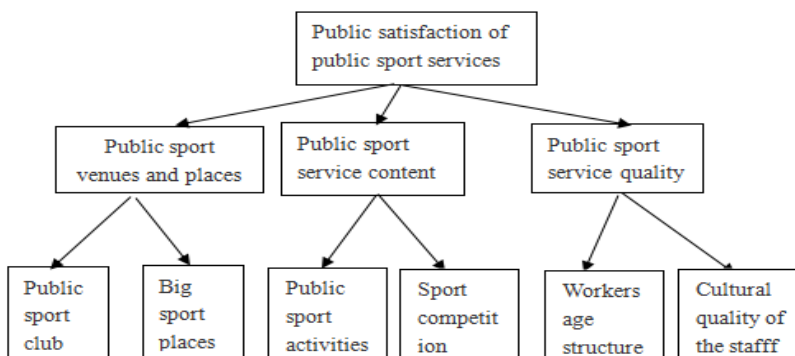


Figure 1 : Public sport services evaluation index

Above Figure 1 is public sports service each grade influence factors, from which public sport venues and places mainly contain public sport club and big sport places, public sport service content mainly contains public sport activities and sports competition, public sport service quality mainly contains workers age structure and cultural quality of the staff. According to above numerous indicators, utilize grey correlation degree analysis method, screen second grade indicators that have close relations with above first grade indicators, so that further improve model, carry on grey correlation AHP approach's public sports service satisfaction index analysis.

Public sports service's public satisfaction index system is a comprehensive evaluation system that joint composed of public sport venues and places, public sport service content and public sport service quality and others first grade factors, as well as public sport club, big sport places, public sport activities, sport competition, workers age structure, cultural quality of the staff and others second grade indicators, now respectively make grey correlation degree analysis of them, and further define one indicator that has larger correlation degrees with system.

Public sports venues and places

The merits of sports venues construction are related to sports venues number of people flow, and then affect public satisfaction index. Public sports venues and its places are direct factors that affect public sports services, are foundation for public carrying out public sports services evaluation. Below TABLE 1 is year 2008~2012 Chinese public sport clubs, big sport places and sports venues construction amount and total flow number of people changes, data is from statistical yearbook in2013.

TABLE 1 : 2008~2012 public sports venues and places status

Year	Total flow number of people(Ten thousand people)	Sport club	Big sport places	Sport venues
2008	31295.7	2820	41156	1893
2009	31468.7	2850	41959	2252
2010	32167.5	2884	43382	2435
2011	32823.3	2952	43675	2650
2012	38151	3076	43876	3069

Record influence factors characteristics behaviors sequence as following:

$$x_i' = (x_i'(1), x_i'(2), x_i'(3))^T, i = 1, 2, 3 \text{ from which correlation factor line sequence is:}$$

$$x_1' = (2820, 2850, 2884, 2952, 3076);$$

$$x_2' = (41156, 41959, 43382, 43675, 43876);$$

$$x_3' = (1893, 2252, 2435, 2650, 3069)$$

Thereupon, it can get: $x_i' = \begin{pmatrix} 2820 & 41156 & 1893 \\ 2850 & 41959 & 2252 \\ 2884 & 43382 & 2435 \\ 2952 & 43675 & 2650 \\ 3076 & 43876 & 3069 \end{pmatrix}$

Define reference sequence, take total flow number of people sequence x_0' as reference sequence:

$$x_0' = (31295.7, 31468.7, 31267.5, 32823.3, 38151)$$

Initialization method data processing, utilize formula $x_i(k) = \frac{x_i'(k)}{x_i'(1)}$, to handle with relative factors line sequence, result is as following :

$$x_1(k) = \frac{x_1'(k)}{x_1'(1)} = \frac{(2820, 2884, 2850, 2952, 3076)}{2820} = (1, 1.02, 1.01, 1.05, 1.09)$$

$$x_2(k) = \frac{x_2'(k)}{x_2'(1)} = \frac{(41156, 41959, 43382, 42675, 43876)}{41156} = (1, 1.02, 1.05, 1.04, 1.07)$$

$$x_3(k) = \frac{x_3'(k)}{x_3'(1)} = \frac{(1893, 2252, 2435, 2650, 3069)}{1893} = (1, 1.19, 1.29, 1.40, 1.62)$$

Calculate $\min_{1 \leq i \leq 3} \min_{1 \leq k \leq 3} |x_0' - x_i(k)|, \max_{1 \leq i \leq 3} \max_{1 \leq k \leq 3} |x_0' - x_i(k)|$:

$$\min_{1 \leq i \leq 3} \min_{1 \leq k \leq 3} |x_0' - x_i(k)| = 21118.1$$

$$\max_{1 \leq i \leq 3} \max_{1 \leq k \leq 3} |x_0' - x_i(k)| = 74410.2$$

Calculate correlation coefficient, below is correlation coefficient computational formula:

$$\zeta_i(k) = \frac{\min_{1 \leq i \leq n} \min_{1 \leq k \leq m} |x_0'(k) - x_i(k)| + \rho \times \max_{1 \leq i \leq n} \max_{1 \leq k \leq m} |x_0'(k) - x_i(k)|}{|x_0'(k) - x_i(k)| + \rho \times \max_{1 \leq i \leq n} \max_{1 \leq k \leq m} |x_0'(k) - x_i(k)|}$$

Among them, ρ is resolution ratio, and $\rho \in (0, 1)$, $\rho = 0.5$, ρ gets bigger and then relation is bigger.

Input $|x_0'(k) - x_i(k)|$ each value, and can solve:

$$\zeta_1 = (0.851, 0.849, 0.841, 0.833, 0.774);$$

$$\zeta_2 = (0.850, 0.837, 0.840, 0.829, 0.767);$$

$$\zeta_3 = (0.847, 0.835, 0.841, 0.827, 0.756)$$

Calculate correlation degree, use correlation degree computational formula $r_i = \frac{1}{m} \sum_{k=1}^m \zeta_i(k)$, input

above values and can get:

$r_1 = 0.8296, r_2 = 0.8246, r_3 = 0.8212$ And then it gets following data TABLE 2.

TABLE 2 : Grey correlation degree value

	Sport club	Big sport places	Sport venues
Correlation degree	0.8246	0.8296	0.8212

By above statistical TABLE 2, it can get conclusion: big sport places and sports service industry total flow number of people correlation degree is the highest that is 0.8296, secondly is sport club and sport places. By the three correlation degree values, it is clear that the three's impacts on sports service industry total flow number of people have no big differences, but sport club and big sport places are relative higher.

Public sports service contents

Public sports services are important parts of present people's life, are important evaluation indicators of public's satisfaction on society. Its contents are colorful, various, from which mainly have public sports activities, and major sports competitions, sports lotteries and so on. Citizen participation times in the kind of activities are direct reflection that whether citizen is satisfied with Chinese public sports service industry or not, high participation frequency indicates that public sports service has done a good job. Below TABLE 3 is several main services forms of Chinese publics sports services, data is from Chinese statistical yearbook.

TABLE 3 : Public cultural services forms

Year	Person-time of participation	Public sports activities	Major sports competitions	Sports lotteries
2008	307529000	41814	1944	2988
2009	308746000	41828	2137	3015
2010	308769000	42749	2112	2994
2011	318745000	42958	1956	3143
2012	319580000	43876	2364	3095

Similarly utilize grey correlation degree to calculate public sports activities, major sports competitions, sports lotteries the three correlation degree values with person-time of participation; it gets following TABLE 4 data.

TABLE 4 : Correlation degree value

	Public sports activities	Major sports competitions	Sports lotteries
Correlation degree	0.8275	0.8223	0.8288

By above statistics TABLE 4, it can get conclusions: in correlation analysis of public sports activities, major sports competitions and sports lotteries, sports lotteries and person-time of participation correlation degree value is the largest that is 0.8288, secondly is public sports activities and major sports competitions. Now extract two factors to make further model improvement analysis, extracted factors are sports lotteries and public sports activities.

Public sport service quality

Workers that go in for public sports services are external expression of public sports service industry, are direct spreader on whether their service qualities are good or bad. Only good images, excellent qualities, higher cultural standards then can spread positive information to public and public may select to be served. Therefore, public sports servers working attitude, working enthusiasm, age structure and others bring impacts on served objects to a certain extent.

By far, with economic development, public demands on spiritual life also increase, when taking physical exercise, their requirements on public sports services are also becoming higher, public sports activities participation times increasingly grow, and Chinese public sports service institutions staff quantity is in short supply.

ANALYTIC HIERARCHY PROCESS-BASED PUBLIC SPORTS SERVICE PUBLIC SATISFACTION INDEX MODEL

By above grey correlation degree analysis of public sports service public satisfaction index evaluation indicators, it can get that main factors affect Chinese public sports service public satisfaction index are the number of big sport places, sports lotteries, and the number of public sport services.

Therefore, further adopt analytic hierarchy process to make further indicators evaluation, establish analytic hierarchy process method-based public sports service public satisfaction index model, and then define Chinese citizen satisfaction indexes sizes on the three, then further find Chinese public sports service existing problems in development process.

Model initial establishment

Target layer : Public satisfaction of public sport services

Criterion layer: Scheme influence factors, C_1 is the number of big sport places, C_2 is sports lotteries, C_3 is the number of public sport services.

Scheme layer: A_1 is great satisfaction, A_2 is ordinary, A_3 is not very satisfy

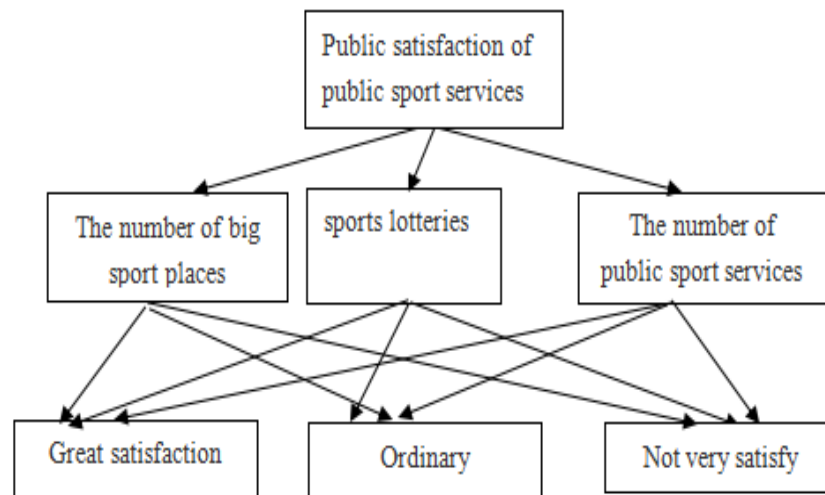


Figure 2 : Hierarchical structural model

By above Figure 2 grey correlation degree method analysis, it is clear that the number of big sport places, sports lotteries, and the number of public sport services are main indicators that affect

public sports services, therefore it can regard them as scheme influence factors to further judge public sports services public satisfaction index.

Construct paired comparison matrix

Construct paired comparison matrix is carrying on paired comparison among elements, using matrix to express each layer every element importance to previous layer all elements, here apply operational research expert proposed 1~9 ratio scale.

TABLE 5 : 1~9 scale definition

Scale a_{ij}	Definition
1	factor i and factor j have equal importance
3	factor i is slightly more important than factor j
5	factor i is relative more important than factor j
7	factor i is extremely more important than factor j
9	factor i is absolute more important than factor j
2, 4, 6, 8	Indicates middle state corresponding scale value of above judgments
Reciprocal of above numerical values	If compare factor i with factor j, it gets judgment value as, $a_{ji} = 1/a_{ij}$, $a_{ij} = 1$

According to above scale TABLE 5, set judgment matrix A as:

$$A = \begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & 1 \end{pmatrix}$$

Obviously, A is positive reciprocal matrix.

And constructed scheme layer judgment matrixes correspond to different criterion layers are as following TABLE 6-8.

TABLE 6 : Criterion layer judgment matrix C_1

C_1	A_1	A_2	A_3
A_1	1	3	5
A_2	1/3	1	4
A_3	1/5	1/4	1

TABLE 7 : Criterion layer judgment matrix C_2

C_2	A_1	A_2	A_3
A_1	1	3	5
A_2	1/3	1	4
A_3	1/5	1/4	1

TABLE 8 : Criterion layer judgment matrix C_3

C_3	A_1	A_2	A_3
A_1	1	2	3
A_2	1/2	1	3
A_3	1/3	1/3	1

Calculate compared element relative weight on the criterion

Consistency test indicator: $CI = \frac{\lambda_{max} - n}{n - 1}$

Random consistency indicator: Randomly generate multiple matrixes, add every matrix consistency indicator and then take average value, it gets RI , as TABLE 9.

TABLE 9 : Random consistency indicator

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Consistency ratio: If $CR = \frac{CI}{RI} < 0.1$, constructed paired comparison matrix A passes consistency test.

Calculate weight, for $A = \begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 3 \\ 5 & 3 & 1 \end{pmatrix}$, firstly handling as following:

$$\begin{aligned} &\xrightarrow{\text{Column vector normalization}} \begin{pmatrix} 0.699 & 0.670 & 0.845 \\ 0.699 & 0.670 & 0.507 \\ 0.140 & 0.228 & 0.169 \end{pmatrix} \\ &\xrightarrow{\text{According to the row sum}} \begin{pmatrix} 2.214 \\ 1.876 \\ 0.537 \end{pmatrix} \xrightarrow{\text{The normalized}} \begin{pmatrix} 0.738 \\ 0.625 \\ 0.179 \end{pmatrix} = W^0 \end{aligned}$$

And then, by $A \times W^0 = \begin{pmatrix} 2.258 \\ 1.900 \\ 0.533 \end{pmatrix}$ it further solves $\lambda^0_{max} = 3.026$.

Similarly, criterion layer judgment matrix corresponding maximum feature value and feature vector are successively:

$$\lambda^{(1)}_{max} = 2.874, \omega_1 = \begin{pmatrix} 0.883 \\ 0.413 \\ 0.140 \\ 0.135 \end{pmatrix}; \lambda^{(2)}_{max} = 2.874, \omega_2 = \begin{pmatrix} 0.883 \\ 0.413 \\ 0.140 \\ 0.135 \end{pmatrix};$$

$$\lambda_{\max}^{(3)} = 2.865, \omega_3^1 = \begin{pmatrix} 0.875 \\ 0.406 \\ 0.141 \\ 0.137 \end{pmatrix}; \lambda_{\max}^{(4)} = 2.853, \omega_3^1 = \begin{pmatrix} 0.873 \\ 0.412 \\ 0.144 \\ 0.131 \end{pmatrix}$$

By calculation, it can get paired comparison matrix A maximum feature value $\lambda_{\max} = 3.026$, $RI = 0.58$.

By consistency indicator $CI = \frac{\lambda_{\max} - n}{n - 1}$, input data, it can calculate and get $CI = \frac{3.026 - 3}{3 - 1} = 0.013$.

And by consistency ratio $CR = \frac{CI}{RI} = \frac{0.013}{0.58} = 0.022 < 0.1$, so constructed paired comparison matrix A passes consistency test. Similarly, it can verify criterion layer judgment matrixes also pass consistency test.

Calculate combination weight vector, by $W^1 = (\omega_1, \omega_2, \omega_3)$, and $W = W^1 \times W^0$ it can calculate and get $W = \begin{pmatrix} 0.507 \\ 0.273 \\ 0.220 \end{pmatrix}$.

CONCLUSION

From above analytic hierarchy process result, it can get conclusions that for Chinese public sports services public satisfaction index, there are 50.7% citizens are very satisfied, 27.3% people are relative satisfied; only 22.0% people are not so satisfied. Thereupon, though nearly half public are very satisfied with Chinese public sports service industry, Chinese public sports industry still has many shortcomings, government supports are not big, public servers qualities are not high, cultural standards are lower, public sports facilities construction are not sound and others, all are main factors that restrict Chinese public sports service development, and further affect Chinese public satisfaction index on them. Therefore, future public sports service should focus on these points, put emphasis on solving public sports development process's masses reflected series of problems, start from base, strive for doing well in public sports service industry, promote public satisfaction index, wholeheartedly serve to masses, and then promote Chinese sports development.

(1)The paper firstly takes intuitional evaluation indicators that evaluate public sports service quality as research objects, by analyzing each evaluation indicator second grade influence factors, and establishing public satisfaction index-based grey correlation degree model, by comparing correlation degrees values, it extracts indicators that have maximum influence on public satisfaction index to make further analysis.

(2)Secondly, on the basis of grey correlation degree method, the paper utilizes analytic hierarchy process method, establishes public sports service public satisfaction index evaluation model, evaluates public satisfaction index on Chinese public sports services. By comparing evaluation weights, finally it gets conclusion: in current stage most public is very satisfied with public sports service, fewer people feel normal, but there are little people not so satisfied .It shows Chinese public sports services still have problems, government should enlarge supports on public sports services, perfect management mechanism, increase servers amount, strengthen public sports venues and places construction, with public benefits at the core, wholeheartedly serve to people.

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